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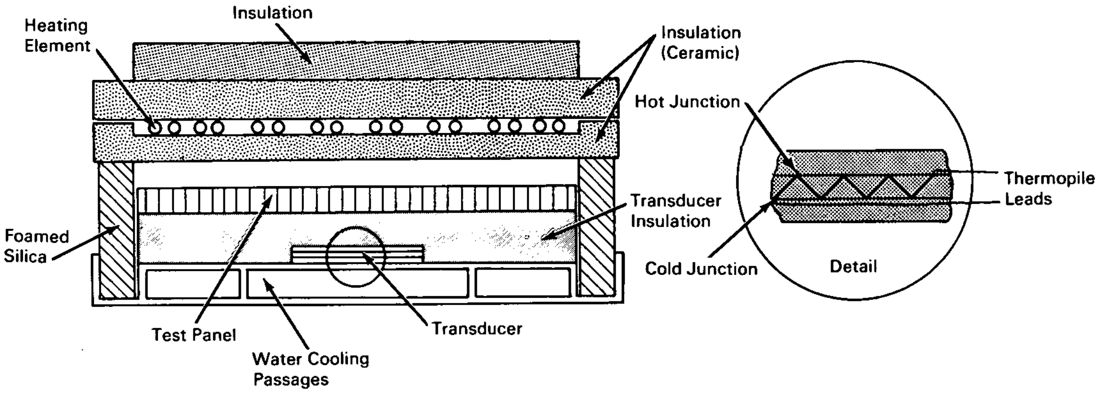
NASA TECH BRIEF

Apparatus Measures Thermal Conductivity of Honeycomb-Core Panels



The problem:

To devise an experimental method for measuring the overall thermal conductivity of honeycomb-core panels at elevated temperatures (670° to 1050°K). Since at the higher temperatures, there are three significant modes of heat transfer (conduction, convection, and radiation) through such panels, it is difficult to determine their overall thermal conductivity by analytical calculations.

The solution:

The measurements are made on panels of sufficient surface area to ensure a negligible lateral heat flow in an apparatus consisting of a heater assembly and a calibrated heat-rate transducer, with sufficient space between the heater and transducer for insertion of a test panel and insulation.

How it's done:

The heat-rate transducer is bonded to a water-cooled metal plate with a cement of high thermal conductivity. The insulation that separates the transducer from the test panel has a thermal conductivity closely matching that of the transducer. This insulation has the two-fold purpose of raising the average temperature of the test panel and preventing the transducer from overheating.

The transducer, which produces an electromotive force proportional to the heat-flow rate, is composed of a silver-constantan thermopile. This thermopile is arranged in a thin phenolic resin plate sandwiched between two other phenolic resin plates. The series of thermocouples making up the thermopile is positioned so that one set of junctions is on one face of the middle plate and the other set of junctions is on the opposite face of the middle plate. Heat flow by radiation from the ceramic plate supporting the heating elements causes a difference in temperature across the middle plate and thus generates an electromotive force.

In making a measurement, the conductivity apparatus, with the test panel in place, is sealed in a vacuum chamber which is then evacuated to a pressure of 500 microns of mercury. A controlled current is

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then applied to the heating elements to bring the top surface of the test panel up to the desired temperature and ensure a steady-state heat-flow rate through the panel, as indicated by a constant output from the heat-rate transducer. The recorded output value from the transducer is used to calculate the overall thermal conductivity of the test panel.

Notes:

1. Further information concerning the apparatus and method of measurement is given in NASA TN D-2866, "Experimental Verification of an Analytical Determination of Overall Thermal Conductivity of Honeycomb-Core Panels" by C. W. Stroud, June 1965, available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia, 22151.
2. Inquiries may also be directed to:
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Patent status:

No patent action is contemplated by NASA.

Source: (Langley-202)